Claims

[c1] A method comprising the step of extruding a heat exchanger tube in an extrusion direction through a die so that the tube has at least one internal passage extending in a longitudinal direction parallel to the extrusion direction, an external surface having a cross-sectional shape in a plane transverse to the extrusion direction, and at least one integral fin parallel to the extrusion direction and extending in a direction away from the external surface of the tube.

[c2] A method according to claim 1, wherein the external surface has two oppositely-disposed flat surfaces and two oppositely-disposed lateral surfaces, and the cross-sectional shape of the tube is oblong as a result of the flat surfaces having larger cross-sectional dimensions than the lateral surfaces.

[c3] A method according to claim 2, wherein the at least one integral fin comprises a plurality of integral fins, and all of the integral fins are present on the flat surfaces of the tube.

[c4] A method according to claim 1, further comprising the step of performing an operation on the at least one integral fin so that the at least one integral fin has alternating first and second portions, the first portions extending a greater distance from the external surface of the tube than the second portions.

[c5] A method according to claim 4, wherein the operation

comprises selectively bending regions of the at least one integral fin to form the second portions thereof.

[c6] A method according to claim 4, wherein the operation comprises selectively removing regions of the at least one integral fin to form the second portions thereof.

[c7] A method according to claim 4, wherein the operation comprises actuating punches in a direction normal to the longitudinal direction of the tube to engage the at least one integral fin and define the first and second portions thereof.

[c8] A method according to claim 1, further comprising the step of removing a portion of the at least one integral fin from the tube adjacent an end of the tube, wherein as a result the integral fin has a terminal portion a longitudinal distance from the end of the tube.

[c9] A method according to claim 8, further comprising the step of assembling the tube with a manifold by inserting the end of the tube through a port in a wall of the manifold, the end of the tube being inserted through the port until the terminal portion of the at least one integral fin abuts the wall of the manifold, the longitudinal distance between the terminal portion and the end of the tube establishing the extent to which the end of the tube projects into the manifold.

[c10] A method according to claim 9, wherein the tube is one of a

plurality of tubes formed by the extruding step, the method further comprising the step of performing an operation on each of the tubes so that the at least one integral fin of each tube has alternating first and second portions and the first portions extend a greater distance from the external surface of each tube than the second portions thereof, and the assembling step comprises inserting ends of the tubes through ports in the wall of the manifold so that the first portions of the tubes are aligned with each other and the second portions of the tubes are aligned with each other to define passages between the tubes.

[c11] A method according to claim 9, wherein the manifold is formed to have an external surface with an oblong cross-sectional shape and comprises two oppositely-disposed flat surfaces, one of the flat surfaces defining the wall of the manifold in which the port is present.

[c12] A method according to claim 11, wherein the wall of the manifold is formed by brazing a cladding sheet to a base profile in which an internal passage is defined, the base profile having a slot and the cladding sheet having an opening that together define the port in which the end of the tube is inserted.

[c13] A method comprising the steps of:

extruding heat exchanger tubing in an extrusion direction

through a die so that the tubing has multiple internal passages extending in a longitudinal direction parallel to the extrusion direction, an external surface having an oblong cross-sectional shape defined by oppositely-disposed flat surfaces and two oppositely-disposed lateral surfaces, and multiple integral fins on the flat surfaces, parallel to the extrusion direction, and extending in directions normal to the flat surfaces of the tubing;

performing an operation on the integral fins so that each of the integral fins has alternating first and second portions, the first portions extending a greater distance from the flat surfaces of the tubing than the second portions;

separating the tubing into a plurality of tubes so that each of the integral fins of each tube has oppositely-disposed terminal portions spaced longitudinal distances from oppositely-disposed ends of the tube;

and assembling the tubes with manifolds by inserting the ends of the tubes through ports in walls of the manifolds, the ends of the tubes being inserted into the ports until the terminal portions of the integral fins abut the walls of the manifolds, the longitudinal distances between the terminal portions and the ends of the tubes establishing the extent to which the ends of the tubes project into the manifolds.

[c14] A method according to claim 13, wherein the integral fins are

present exclusively on the flat surfaces of the tubing and the tubes are assembled with the manifolds so that the integral fins of the tubes are substantially parallel and the integral fins of each of the tubes extend toward an adjacent one of the tubes.

[c15] A method according to claim 13, wherein the operation comprises selectively bending regions of each of the integral fins to form the second portions thereof.

[c16] A method according to claim 13, wherein the operation comprises selectively removing regions of each of the integral fins to form the second portions thereof.

[c17] A method according to claim 13, wherein the operation comprises actuating punches in a direction normal to the longitudinal direction of the tubing to engage the integral fins and define the first and second portions thereof.

[c18] An extruded heat exchanger tube having at least one internal passage extending in a longitudinal direction parallel to an extrusion direction of the tube, an external surface having a cross-sectional shape in a plane transverse to the extrusion direction, and at least one integral fin parallel to the extrusion direction and extending in a direction away from the external surface of the tube.

[c19] An extruded heat exchanger tube according to claim 18,

wherein the external surface of the tube has two oppositely-disposed flat surfaces and two oppositely-disposed lateral surfaces, and the cross-sectional shape of the tube is oblong as a result of the flat surfaces having larger cross-sectional dimensions than the lateral surfaces.

[c20] An extruded heat exchanger tube according to claim 19, wherein the at least one integral fin comprises a plurality of integral fins, and all of the integral fins are present on the flat surfaces of the tube.

[c21] An extruded heat exchanger tube according to claim 18, wherein the at least one integral fin has alternating first and second portions, the first portions extending a greater distance from the external surface of the tube than the second portions.

[c22] An extruded heat exchanger tube according to claim 21, wherein the second portions of the at least one integral fin are defined by bent regions of the at least one integral fin.

[c23] An extruded heat exchanger tube according to claim 21, wherein the second portions of the at least one integral fin are defined by removed regions of the at least one integral fin.

[c24] An extruded heat exchanger tube according to claim 18, wherein the at least one integral fin has a terminal portion a longitudinal distance from the end of the tube.

[c25] An extruded heat exchanger tube according to claim 24,

wherein the tube is assembled with a manifold with the end of the tube residing in a port in a wall of the manifold and the terminal portion of the at least one integral fin abuts the wall of the manifold.

[c26] An extruded heat exchanger tube according to claim 25, wherein the tube is one of a plurality of extruded heat exchanger tubes assembled with the manifold, each tube having at least one internal passage extending in a longitudinal direction parallel to an extrusion direction of the tube, an external surface having a cross-sectional shape transverse to the extrusion direction, and at least one integral fin parallel to the extrusion direction and extending in a transverse direction away from the external surface of the tube, the at least one integral fin of each tube having alternating first and second portions, the first portions extending a greater distance from the external surface of the tube than the second portions, the first portions being aligned with each other so that passages between the tubes are defined by the second portions.

[c27] An extruded heat exchanger tube according to claim 25, wherein the manifold is formed to have an external surface with an oblong cross-sectional shape and comprising two oppositely-disposed flat surfaces, one of the flat surfaces defining the wall of the manifold in which the port is present.

[c28] A heat exchanger having a pair of manifolds and extruded tubes fluidically connected to the manifolds to allow fluid flow to and from the manifolds through the tubes, each of the tubes comprising:

multiple internal passages extending in a longitudinal direction parallel to an extrusion direction of the tube;

an external surface having an oblong cross-sectional shape defined by oppositely-disposed flat surfaces and two oppositely-disposed lateral surfaces; and

multiple integral fins on the flat surfaces, parallel to the extrusion direction, and extending in directions normal to the flat surfaces of the tube, each of the integral fins having alternating first and second portions and oppositely-disposed terminal portions spaced longitudinal distances from oppositely-disposed ends of the tube, the first portions extending a greater distance from the flat surfaces of the tube than the second portions;

wherein the tubes are assembled with manifolds with the ends of the tubes residing in ports in walls of the manifolds and the terminal portions of the integral fins abutting the walls of the manifolds, the tubes being oriented so that the integral fins of adjacent pairs of the tubes are substantially parallel and the integral fins of each of the tubes extend toward an adjacent one of the tubes.

[c29] A heat exchanger according to claim 28, wherein the integral fins are present exclusively on the flat surfaces of the tubes.

[c30] A heat exchanger according to claim 28, wherein the second portions of the integral fins are defined by bent regions of the integral fins.

[c31] A heat exchanger according to claim 28, wherein the second portions of the integral fins are defined by removed regions of the integral fins.